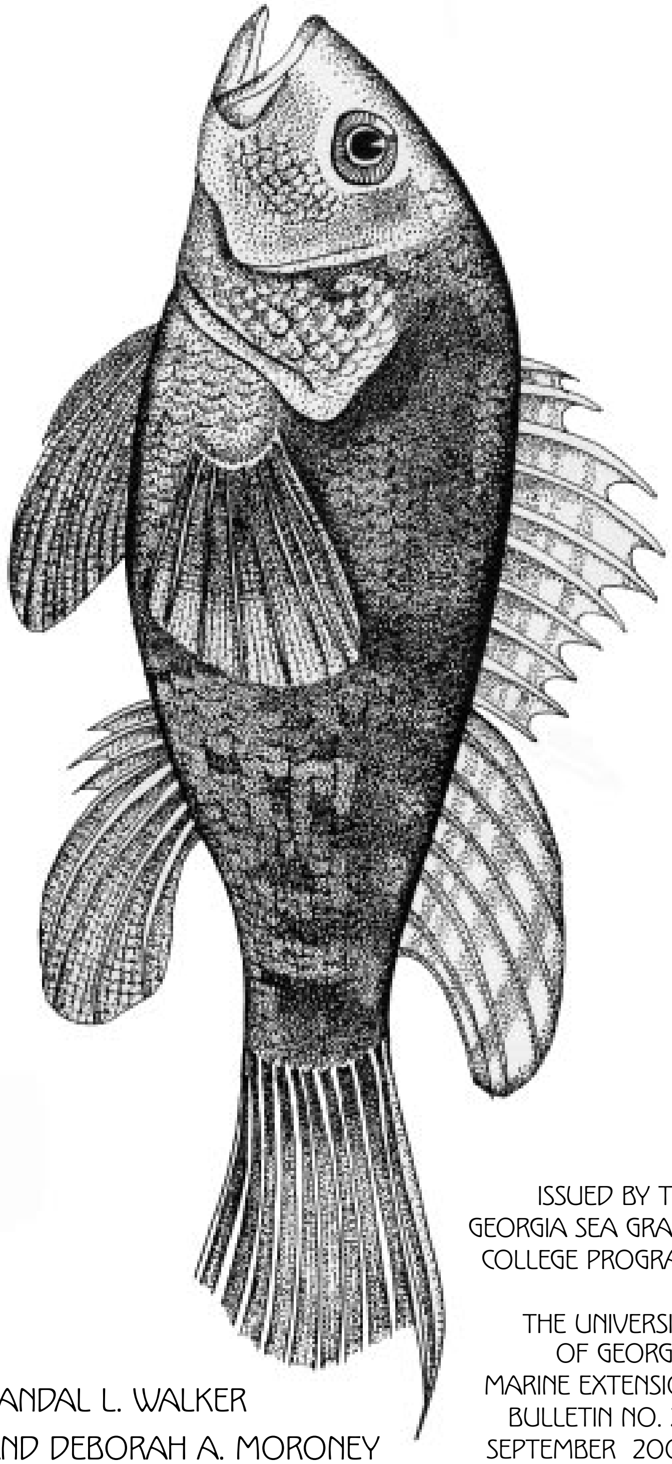
GROWTH OF JUVENILE BLACK SEA BASS, <u>CENTROPRISTIS STRIATA,</u> FED EITHER A COMMERCIAL SALMON OR TROUT DIET



ISSUED BY THE
GEORGIA SEA GRANT
COLLEGE PROGRAM

THE UNIVERSITY
OF GEORGIA,
MARINE EXTENSION
BULLETIN NO. 22,
SEPTEMBER 2000

RANDAL L. WALKER
AND DEBORAH A. MORONEY

ACKNOWLEDGMENTS

The authors wish to thank Mr. Gray Kinard for his expert advise and in collecting the fish, Ms. L. Thompson for her help in weighing the fish, and Mr. D. Hurley for reviewing the manuscript. Also, the authors wish to thank three anonymous reviewers for improving the quality of the manuscript. This work was supported by funds from the University of Georgia Marine Extension Service.

GROWTH OF JUVENILE BLACK SEA BASS, *CENTROPRISTIS STRIATA*, FED EITHER A COMMERCIAL SALMON OR TROUT DIET

RANDAL L. WALKER
AND
DEBORAH A. MORONEY

SHELLFISH AQUACULTURE LABORATORY
MARINE EXTENSION SERVICE
UNIVERSITY OF GEORGIA
20 OCEAN SCIENCE CIRCLE
SAVANNAH, GA 31411-1011

TABLE OF CONTENTS

LISTS OF TABLES AND FIGURES

ABSTRACT

An opportunity exists to expand Georgia's commercial fishery by developing aquaculture techniques for the black sea bass, *Centropristis striata*. Black sea bass fillets sell for \$1.25 to \$1.50 per 0.45 kg wholesale. However, live, 0.9 to 1.13 kg fish are sold on the sushi market at a wholesale price of \$3.50 to \$8.00 per 0.45 kg. Little biological information exists concerning the culture of this potential aquaculture species. Six 600-L tanks on a flow-through system were stocked with 12 juvenile fish each (ranging in total length from 153 to 235 mm). Fish were pot-trapped from an offshore population. Tanks (3 for each diet) were randomly assigned a diet of either a commercial trout or salmon chow. Fish were fed a two percent daily ration (grams dry weight of food to grams wet weight of fish). Rations were adjusted biweekly to account for fish weight increases per treatment. Fish fed the salmon chow were significantly heavier after 10 weeks ($P = 0.0209$) and after 14 weeks ($P = 0.0003$) than fish fed the trout chow. Fish fed trout chow increased from 196 grams to 304 grams (55% increase) in 14 weeks, while fish fed the salmon chow increased from 163 grams to 386 grams (137% increase). Based upon fish growth and cost of feed, salmon chow is the preferred diet over trout chow for rearing black sea bass.

INTRODUCTION

As natural fish stocks continue to dwindle, many experts acknowledge that the world's natural fisheries are in serious trouble (Avault 1996). Furthermore, it is widely recognized that aquaculture is a future means for producing many types of seafood in the United States (Avault 1996).

Expanding Georgia's commercial fishery by developing aquaculture techniques for the black sea bass, *Centropristis striata*, is a timely idea. Black sea bass fillets sell for an average of $1.25 to $1.50 per 0.45 kg wholesale. However, live, 0.9 to 1.13 kg (2 to 2.5 pounds) fish are sold on the American and Canadian wholesale sushi markets at $3.50 to $4.50 per 0.45 kg. In 1997, live fish sold for as much as $8.00 per 0.45 kg (Mr. Gary Kinard, a McIntosh County, Georgia fisherman, personal communications). Sushi has become very popular in the United States. In the Atlanta, Georgia area alone, 43 restaurants listed on the World Wide Web serve sushi. Many large American cities now have Sushi Societies which cater to consumers of sushi. The demand for seafood, including sushi, is increasing nationwide. One Georgia fisherman is producing a limited number of fish for the sushi market. Fish are shipped live to markets in New Jersey and New York, U.S.A. and Toronto, Canada.

Currently, minimum-legal-size black sea bass, ≥25.4 cm length, are pot-trapped or caught offshore by hook and line, kept in live wells aboard ship until the vessel docks, and then placed into land-based tanks. Fish in the tanks are fed commercially available trout food. Mr. Gray Kinard has approached Georgia Marine Extension Service's Shellfish Aquaculture Laboratory for information and aid in culturing these fish.

One of the questions we are being asked by the fishermen is: What is the best commercially available fish food for growing black sea bass? According to Harpster *et al.* (1977), trout chow was the best food available in the 1970's for the Gulf of Mexico subspecies of black sea bass, *C.s. malana*; however, a wider variety of commercial fish foods is available today. This study compares the growth of black sea bass fed two common commercially available fish chows: trout versus salmon chow.

MATERIAL AND METHODS

Fish were pot-trapped from an offshore population on January 5, 1998. Fish were caught aboard Mr. Gary Kinard's snapper boat, which is licensed to trap black sea bass. Fish were kept in live wells aboard the boat. Then they were held in Mr. Kinard's shore-based tanks for several days before being placed in a tank in the back of a truck which brought them to the laboratory on Skidaway Island, Georgia. Upon arrival at the laboratory, fish were placed into a 42,000-L flow-through tank receiving ambient seawater. Fish were fed trout chow pellets during the acclimation process. After four days, fish appearing in good health were selected for the experiment.

Six 600-L fiberglass tanks were stocked with 12 juvenile black sea bass each (range from 153 mm to 235 mm total length). Each tank received water from the Skidaway River at a flow rate of 10 liters per minute. The water previously passed through a gravel and sand filter. Water salinity and temperature were monitored daily. Each tank was aerated with an airstone supplied by the laboratory's main air blower system.

Diet treatment was randomly assigned to each tank with three replicate tanks per diet of either trout or salmon chow. Fish were fed an optimum 2% ration (grams dry weight of food to grams wet weight of fish) (Kupfer *et al.* 2000)(Table 1). The fish in each tank were weighed biweekly prior to cleaning each tank. Ration was adjusted upward biweekly according to the new pooled mean weight of fish in the three replicate tanks per treatment (Fig. 1). Tanks were stocked with fish on January 9, 1998 and the study was terminated on April 20, 1998.

Analysis of Variance ($\propto = 0.05$) was used to determine if significant differences in mean fish weight occurred between diets. There were no significant differences ($P = 0.2441$) between the initial mean weights of fish in both treatments on January 9, 1998, the start of the experiment. Survival data were assumed not normally distributed and were arcsine transformed. ANOVA was used to determine if significant differences in percent survival of fish occurred.

Table 1. Comparison of Salmon and Trout Chow used to culture the black sea bass, *Centropristis striata*. The High-performance Trout Chow was used in a prior feeding experiment (Kupfer *et al.* 2000).

	TROUT CHOW	SALMON CHOW	HIGH-PERFORMANCE TROUT CHOW
Manufacturer	Zeigler	Fundy Choice XE	Zeigler
Product	Trout Grower	Salmon Grower	High-Performance
Pellet type	Floating	Floating	Floating
Pellet size (dia. in inches)	3/32	5/32	3/32
% Crude protein	38.0	45.0	45.0
% Crude fat	8.0	26.0	12.0
% Crude fiber	4.0	2.0	1.0
Cost per 50 lb bag	$16.96	$25.00	$22.36

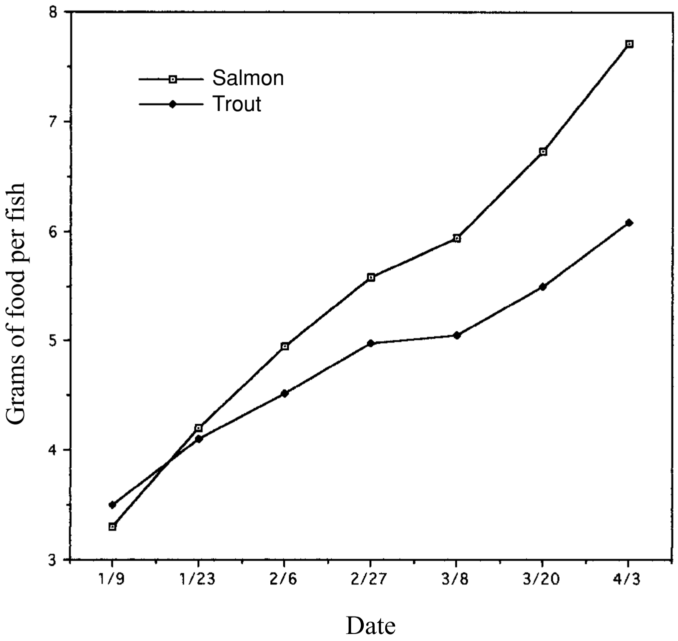


Figure 1. The biweekly ration in grams of pellets per fish of Trout Chow and Salmon Chow fed to black sea bass, *Centropristis striata* in culture.

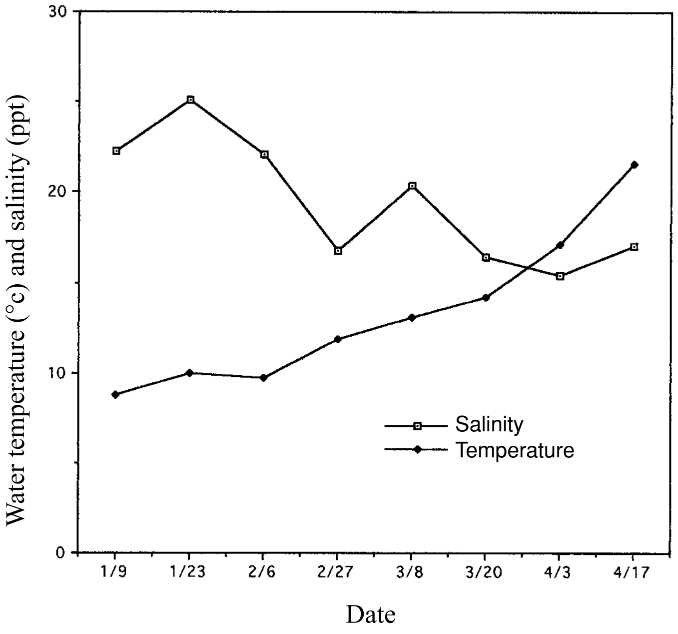


Figure 2. Water temperature (° C) and salinity (ppt) of ambient seawater from the Skidaway River.

RESULTS

Mean monthly water temperatures of the Skidaway River (Fig. 2) dropped from 13.3°C in January to a low of 12.5°C in February and recovered to a high of 25°C by May. Salinity dipped from 16.5 ppt in January to a low of 13.7 ppt in March and increased to 15 ppt by May 1998.

No significant differences in mean fish weight occurred between treatments from January 9 to March 6, 1998 (week 8) (Fig. 3). By week 10 (March 20, 1998), fish fed the salmon chow were significantly larger ($P = 0.0209$) than those fed the trout chow. Fish fed the trout chow had a mean weight of 252.7 ± 12.5 (SE) grams as compared to 296.7 ± 13.5 grams for those fed the salmon chow. By week 14, fish fed the salmon chow (385.8 ± 14.7 grams) were very much larger ($P = 0.0003$) than fish fed the trout chow (304.2 ± 14.9 grams). In 14 weeks, fish fed the trout chow increased 55% in biomass, while fish fed the salmon chow increased 137% in weight.

Survival of fish fed the salmon ration was 97.2% ± 2.8% compared to 88.9% ± 7.3% for fish fed trout chow. No significant differences ($P = 0.3902$) in fish survival were determined.

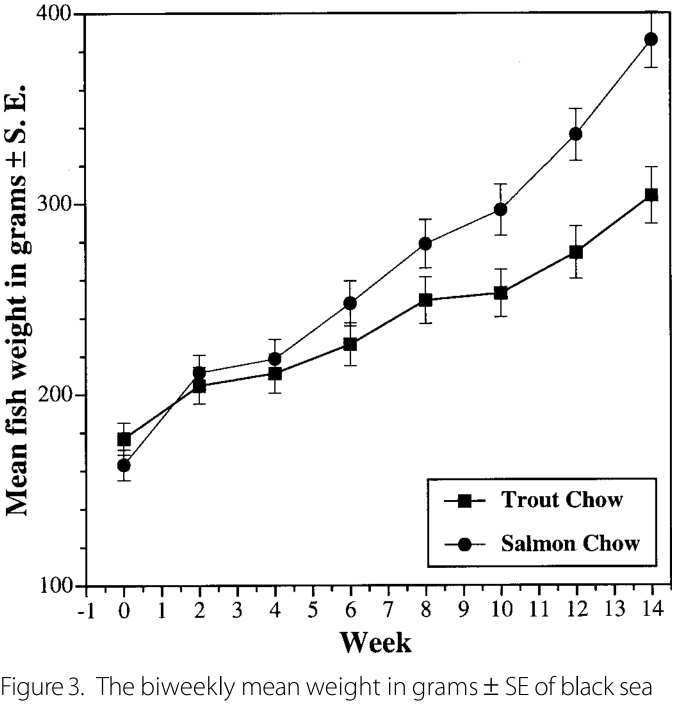


Figure 3. The biweekly mean weight in grams ± SE of black sea bass, *Centropristis striata*, fed either Trout or Salmon Chow.

DISCUSSION

Results of this study showed that black sea bass fed salmon chow at a 2% ration attained a greater weight increase than those fed the same ration of trout chow. The percent increase in weight for fish fed the salmon ration (137%) over the study period was almost 2.5 times greater than that for the trout chow (55%). One possible explanation for the increased growth rate was a higher percentage of both protein (7%) and fat (16%) in the salmon chow (Table 1). However, in prior experimentation (Kupfer *et al*. 2000), a high performance protein trout chow diet (Table 1) did not produce greater growth in fish than regular trout chow after either 71 days or 123 days. A comparative study between a high fat trout chow and the regular salmon and trout chow diets may determine if the increased fat content of the salmon diet was responsible for the greater growth rate of fish observed in the present study.

The Shellfish Aquaculture Laboratory, at the request of industry, currently is testing different commercially available diets for rearing this fish. In a prior experiment (Kupfer *et al*. 2000), 15 fish (range in total length from 117 to 277 mm; mean = 211 mm) in each of three replicate tanks per treatment received a diet of the following: 1) a high performance trout pellet (high protein) at a 2% ration; 2) trout grower pellets at 2% ration; 3) half trout grower and half high performance trout pellets at 2% ration; 4) a high performance trout pellet at a 3% ration; 5) trout grower at 3% ration; and 6) half trout grower and half high performance trout pellets at 3% ration. After 71 days, no significant differences (P = 0.4096) in mean wet weight of fish per treatment occurred. The fish had an overall mean wet weight of 273 grams, a 66% increase in wet weight in 71 days. After 123 days, no significant difference in mean fish weight was observed among the three remaining treatments (1, 2 and 4). Fish from treatments 3, 5 and 6 were lost due to a power failure. Black sea bass had grown from an overall mean weight of 164 grams to 314 grams in 123 days - an increase of 91.5%. A 2% diet of trout chow was found to be the optimum ration, since it did not result in wasted food and costs less than the 2% high performance trout chow.

Black sea bass fed trout grower had comparable growth in this study as compared to the Kupfer *et al.* (2000) study, but the growth of fish fed trout chow was less than half that of fish fed the salmon diet in this study. Kupfer *et al.* (2000) found that fish fed trout grower at a 2% ration increased in weight from 163.9 grams to 300.5 grams in 123 days - a rate of 1.1 grams per day. Fish fed trout grower in this study increased in weight from 196 grams to 304 grams in 98 days - a rate of 1.1 grams per day. Fish fed the salmon diet grew from 163 grams to 386 grams in 98 days - a rate of 2.28 grams per day.

Only four growth studies on juvenile black sea bass are reported [Harpster *et al.* 1977; Kendall 1977; Kim 1987; Costa and Provenzano, 1993 (abstract only)]. Black sea bass juveniles in cultures fed five different diets showed the greatest biomass increase when fed a diet of either trout chow (173%) or chopped squid (181%); however, very high fish mortalities occurred with the squid diet (Harpster *et al.* 1977). Fish fed other diets (Marine Ration 20, Marine Ration 30, and Catfish Cage Chow) performed poorly (<66% weight increase). Kendall (1977) reported that black sea bass grew in captivity from 265 grams to 880 grams in nine months; however, no details on the culture methodology were given. Costa and Provenzano (1993) grew fish from 228 grams to 302 grams in a recirculating system and concluded that the species had excellent potential for closed-system culture. Kim (1987) fed trout chow to black sea bass in a recirculating water system and found that the growth rate of cultured fish was approximately four-to-five times that of wild populations. Also, he found *C. striata* to be hardy in culture but he experienced technical difficulties related to control of ammonia levels within a closed recirculating system.

Although growth of black sea bass fed the trout grower chow was comparable between this study and Kupfer *et al.*'s (2000), environmental factors during cultures were different. While juveniles may be found within the estuaries, adult black sea bass occur primarily offshore in Georgia and South Carolina (Cupka *et al.* 1973). In 1997, fish were cultured in seawater tanks that received ambient water from the Skidaway River. Water temperatures ranged from 11.6°C in January to 25.9°C in June. Water salinity ranged from 24.9 ppt in January to a low of 17.8 ppt in March and increased to 22.9 ppt by June. Water temperatures followed a similar trend in 1998, with a low occurring in February (12.1°C). A steady increase in water temperature occurred up to June (28.5°C). The major difference in environmental parameters between the two studies was lower water salinity in 1998 due to the heavy rains of 1997-98 El Niño. Water salinity decreased from 16.5 ppt in January to a low of 13.7 ppt in March and remained low through May (15 ppt). Water salinity began increasing in June after the rains ceased (up to 19.4 ppt by mid-June). Black sea bass fed trout chow in 1997 had the same growth rate as those cultured under lower-than-normal salinity levels in 1998. Thus, low water salinity appeared to have no effect upon the growth of this marine fish under culture within the estuary.

Salmon chow costs $8.04 more per bag than trout chow (Table 1); however, since salmon chow doubled the growth efficiency rate of black sea bass, it is the preferred diet. The weight increase of the fish utilizing the salmon diet will more than offset the price discrepancy between the two feeds by bringing the fish to market size more quickly. Furthermore, the faster the fish attains market size, the lower the chances of crop loss due to system failure or other causes.

REFERENCES

Avault, J.W., Jr. 1996. Fundamentals of Aquaculture. A Step-by-Step Guide to Commercial Aquaculture. AVA Publishing Company, Inc., Baton Rouge, LA.

Costa, A.J. and J. Provenzano. 1993. Black sea bass, *Centropristis striata*, in closed recirculating systems: Feeding, maintenance and system management. Virginia Journal of Science 44: 95 (Abstract)

Cupka, D.M., K.D. Robert and J. Tucker. 1973. Biology of the Black Sea Bass, *Centropristis striata* (Pisces: Serranidae), from South Carolina waters. South Carolina Wildlife and Marine Resources, Charleston, South Carolina. 93 pp.

Harpster, B.V, D.E. Roberts, Jr. and G.E. Bruger. 1977. Growth and food conversion in juvenile southern bass, *Centropristis melana* (Ginsburg), fed commercial and seminatural diets. Proceedings of the World Mariculture Society 8: 795-809.

Kendall, A.W. 1977. Biological and fisheries data on Black Sea Bass, *Centropristis striata* (Linnaeus). NOAA, United States Department of Commerce, Technical Series Report No. 7, 29 pp.

Kim, J.W. 1987. Growth Potential of Young Black Sea Bass *Centropristis striata*, in Artificial Environments. Doctoral dissertation, Old Dominion University, Virginia.

Kinard, G. 1998. Black Sea Bass Grower. Townsend, GA. Personal communications.

Kupfer, R.W., D.H. Hurley and R.L. Walker. 2000. A comparison of six diets on the growth of Black Sea Bass, *Centropristis striata*, in an aquacultural environment. University of Georgia Marine Extension Bulletin No. 21, 23 pp.